# Backfill

## Free Underground Heat

Across most of the U.S., residential geothermal heating systems depend on electric heat pumps to boost low-grade heat collected from soil or groundwater to temperatures high enough to be useful. But the lucky inhabitants of a few geologically privileged areas can heat their homes by tapping directly into naturally occurring hot groundwater.

One such place is Klamath Falls, Ore. Most of the city's downtown core — including its sidewalks — has been heated by an elaborate municipal geothermal plant since the early 1990s. Area homes and ranches, however, have relied on simpler systems at least since the 1930s.

A well-drilling crew lowers a bundle of PEX piping into a thermal well that will heat a Klamath Falls medical office. Black iron pipe, long the traditional choice for downhole heat exchangers, tends to corrode in the hot mineral-rich groundwater, and typically must be replaced every 20 years or so.

The basic heating setup for each of these residences starts with a thermal well, which is drilled and cased much like a conventional drinking-water well. If suitably hot water is found (temperatures of local thermal wells range from about 120°F to near boiling), the drilling crew then lowers one or more downhole heat exchangers — essentially doubled lengths of standard plumbing pipe joined at the bottom with 180-degree elbows — into the casing. Typically, a pair of 1½-inch pipes is used for space heating and a separate pair of ¾-inch pipes for domestic hot water.

In many cases, no pump is required to distribute the heat: The heat-exchanger pipes are charged with pressurized city water, which then circulates by natural convection to cast-iron or conventional baseboard radiators. For forced-air systems, the heated water is circulated through the coils of an air handler with a small booster pump.

While a hot-groundwater system can be pricey to install — drilling a well costs roughly $50 per foot, with many wells extending to depths of 300 feet or more — it's notably cheap to operate. John Lund, a professor at the Oregon Institute of Technology (OIT) in Klamath Falls, shares a thermal well with a neighbor. He reports that the complete system, which provides heat and hot water to two homes, cost $15,000 to install back in 1981, but now each household pays only about $10 a month to operate and maintain it, with most of that amount going to electricity for circulation pumps.

Still, free heat does have its drawbacks. Unlike low-temperature geothermal systems that rely on a heat pump, a hot-water geothermal system can't be used to provide summer cooling — not easily, anyway. Another problem, says OIT senior engineer Toni Boyd, is the warmish-to-hot water that flows from many potable-water wells serving residents of areas beyond the reach of city water.

"You know how people want to be the first one to shower so they don't have to worry about running out of hot water?" she says. "They have the opposite problem. The last person to shower sometimes runs out of cold to mix with the hot." — *Jon Vara*